ARMY SMALL BUSINESS INNOVATIVE RESEARCH PROGRAM

I INTRODUCTION AND GENERAL INFORMATION

1. The purpose of the Army's portion of the Small Business Innovative Research Program is to stimulate technological innovation and to use small business to help the Army meet its research and development needs.

2. The portion o the pamphlet is organized to facilitate timely submission of proposals by small businesses directly to the laboratory or agency which will ultimately evaluate the proposal. Listed in the next section are the Army points of contact for the Small Business Innovative Research Program and the addresses to which proposals should be submitted. In the third section are the specific research topics that the Army is interested in investigating through the Small Business Innovative Research Program. After each topic there is a cross reference to the appropriate point of contact.

3. Schedule
   a. To be considered for this program, Phase I proposals must be received by the appropriate Army laboratory/agency not later than 31 May 1983.
   b. Phase II proposals will be a follow/on to Phase I. Only these receiving Phase I awards will be eligible for Phase II. Submission of Phase II proposals should be coordinated directly with the appropriate Army laboratory/agency after the Phase I has been awarded.
   c. Notification of Phase I awards and are expected to be made no later than 30 September 1983.

II POINTS OF CONTACT

Listed below are the addresses of the Army Laboratories and Commands to which Small Business Innovative Research proposals should be submitted. Each activity has a number which provides the cross reference to the Research Topics listed in the next section. The appropriate number of the activity to which a proposal should be sent is listed in parenthesis immediately following each topic.

1. CDR, Construction Engineering Research Laboratory
   ATTN: CERL-PP
   Box 4005
   Champaign, IL 61820

2. CDR, Cold Regions Research Engineering Laboratory
   ATTN: CRREL-PP
   Box 282
   Hanover, NH 03755

3. CDR, Engineering Topographic Laboratory
   ATTN: ETL-PRO
   Ft Belvoir, VA 22060

4. CDR, Waterway Experiment Station
   ATTN: WESVB
   Box 631
   Vicksburg, MS 39180

5. CDR, Army Research Institute for Behavioral and Social Sciences
   ATTN: PERI-PO
   5001 Eisenhower Ave.
   Alexandria, VA 22333

6. CDR, Mobility Equipment Research and Development Command
   ATTN: DRDME—ZK
   Ft Belvoir, VA 22060

7. Director, Army Materials and Mechanics Research Center
   ATTN: DRXMR-PP
   Watertown, MA 02172

8. CDR, Missile Command
   ATTN: DRSMI-RN
   Redstone Arsenal, AL 358983

9. CDR, Natick Laboratories
   ATTN: DRDHA-WA
   Natick, MA 02760

10. CDR, Communications and Electronics Command
    ATTN: DRSEL-POD
    Ft Monmouth, NJ 07703

11. CDR, Tank-Automotive Command
    ATTN: DRSTA-RGI
    Warren, MI 48090

12. CDR, Human Engineering Laboratory
ATTN: DRXHE-CC
Aberdeen Proving Ground, MD 21005

13. CDR, Aviation Research and Development Command
ATTN: DRDAV-N
4300 Goodfellow Rd
St Louis, MO 63120

14. CDR, Armaments Research and Development Command
ATTN: DRDAR-RDR
Dover, NJ 07801

15. CDR, Electronics Research and Development Command
ATTN: DRDEL-CT
2800 Powder Mill Rd
Adelphi, MD 20783

16. PM Training Devices
ATTN: DRCPM-IND
Naval Training Center
Orlando, FL 32813

17. CDR, US Army Medical Research and Development Command
ATTN: SGRD-RMA
Ft Detrick, Frederick, MD 21701

18. CDR, Ballistic Missile Defense System Command
ATTN: BMDSC-CPP (SBIR)
Box 1500
Huntsville, AL 35807

III RESEARCH TOPICS

Our SBIR efforts are specifically directed to take advantage of technologies in which the US enjoys a lead and for which a need exists within the US Army. Our capabilities in areas such as automatic data processing and microelectronics represent national strengths that cannot be matched. By applying such leverage technologies we can develop and field equipment that will enable us to fight our kind of battle rather than an enemy's. with this focus in mind, a large share of the Army's SBIR funding will support work in the Thrust Areas that are listed as follows:

A83-001 TITLE: Very Intelligent Surveillance and Target Acquisitions (VISTA)

DESCRIPTION: Technology that will allow the incorporation of enormous computational power and data processing capabilities into individual sensors and combination of sensors. This area goes well beyond the technology embodied in the current surveillance and target acquisition systems. VISTA is intended to be an information gathering and processing system that provides real-time or near real-time target identification and location information to commanders at each level.

a. Knowledge Representation for Multisensor Correlation (15)

To automate the process of multisensor correlation, it is necessary to create a data structure which represents a history of objects, an incoming sensor report on an unknown item, and the inference machine to compare the new item to the library. Innovative techniques are needed to correct for a lack of speed in retrieval of an item from the library, inaccuracies in correlation when comparing an unknown to the library and unwarranted growth of the data structures. Basic research needs to be conduced in the areas of data structures and predicate calculus.

b. Automated Intelligence Processing Algorithms (15)

This project area is in support of Joint Tactical Fusion Center (JTFC) development and other intelligence producing sensors. Current SIGINT and IMINT sensors produce data the form of message traffic which will be collected, correlated, and fused together by analysts in the Joint Tactical Fusion Center. The project entails: Development of algorithms to automatically collect, correlate, and/or fuse sensor data to produce finished intelligence or assist the JFTC analysis to accomplish their mission. Input/stimulus to evaluate developed algorithms will be in the for of message traffic which would be produced by a variety of intelligence collection sensors. Evaluation of the developed algorithm will be accomplished by comparison of algorithm results to ground truth of the scenario. Successful algorithms will ultimately be incorporated in fielded JTFCs. Potential contractors must possess a secure facility and have personnel assigned to the program who already have Top Secret clearance and access to Sensitive Compartmented Information.

c. Improved Tactical Direction Finding Techniques (15)

The frequency ranges of interest are HF, VHF, and UHF. Primary concern is emitter location accuracy.

d. Frequency Independent Antennas and Couplers (15)

New design techniques and hardware validation demonstrations are required for frequency independent antennas and power amplifier matching networks for application in the frequency band below 30 MHz. The antenna should be lightweight, rapidly erectable and capable of operation while the vehicle on which it is mounted is moving. Techniques would also be developed for the band 20-400 MHz for small airborne vehicles such as unattended aerial vehicles.

e. Artificial Intelligence Applied to Communications EMC (15)

A brace robot jammer is queried having the flexibility to sense its electrical signal environment and to devise the appropriate optimum jamming strategy. The AI program would control all analysis and control functions in the jammer, and be applicable to any size jammer, air or ground.

f. Automatic Tactical Performance Indicators (15)

Real-time and forecast atmospheric conditions for the battle area need to be combined using microprocessor techniques with capabilities of systems and units to give the expected performance of individual weapon and sensor systems, to the tactical commander.

g. Remote Atmospheric Sensing (15)

Visibility, wined velocity, temperature, and humidity affect the performance of electro-optical, artillery, and chemical systems. These atmospheric properties need to be measured remotely with lightweight, low-power consumption, automatic, reliable and easily maintained, near real-time hardware.

h. Multisensor Signal Processing Techniques (15)

Develop signal processing techniques for multiple, collocated, tactical sensors and verify performance with computer simulations. The candidate sensors are thermal imagers, millimeter wave radar, carbon dioxide laser, and acoustics.

i. Field Demonstration of Target Acquisition (15)

The field computer (FPAD) program requires:

(1) 96-bit wide micro coding of image processing/radar processing/CO2 laser processing/acoustic processing macro routines.

(2) Computer board fabrication for FPAD with limited and specified high throughput image processing functions such as hardware correlation and median filters.

(3) Computer to drive servo interface board design and construction for computer control of gimbles and data acquisition from flight instruments.

j. Computer Aided Design of Target Classifiers (15)

The task would be the definition and development of a computer software package for the design and evaluation of statistical classifiers for image processing applications to enable the computer aided design of Automatic Target Recognizer algorithms.

k. Development of Adjustable 3d Generation Power Supply for AN/PVS-7 (15)

Current Power supply design is based on furnishing discrete cathode voltage values. This requires fielding of an estimated four different power supply models to accommodate the various image tube operating requirements. Development of an adjustable design will allow a single power supply to be used, minimizing logistics costs and improving yields.

l. Signature Database Development (15)

Provide application programs which can access System 2000 database through its procedural language interface. Provide software to generate synthetic imagery by inserting targets into different background images. Augment the information in this database by entering target coordinates, target type, and performance statistics.

m. Intelligent Sensor Scoring System (15)

There is a need for the automatic recording of data from and scoring of cueing and tracker sensors. The development of special digital interfaces and digital recording equipment would allow reduction of data in a semiautomatic fashion and to have an insight to the overall functioning of these sensors.

n. Electronic Warfare Research (15)

(1) Research in ELIMI/ESM – Highly accurate, real time detection, identification, and location of noncommunication threats across the entire battlefield area is a primary concern. Antenna, receiver, and signal processing research is required for application to intelligence, VISTA targeting and responsive countermeasure activation.

(2) Research in Support Electronic Warfare – The major concern in this technology thrust area is jammer power management. Techniques applicable to stand-off, high power jammers and very lightweight, penetration jammers are of interest.

(3) Research in Self Protection Countermeasures – This thrust is concerned with advanced countermeasures research in detection, location, and techniques and countering these threats.

(4) Research in Vulnerability/EECM – This area of technology addresses concepts for reducing the vulnerability of electronic US Army C-E Weapon Systems.

(5) Epitaxial Growth of Cadmium-Mercury-Telluride – Advanced growth technique with capability for growing multi-layers of CdHgTe for advanced IR Detector Applications.

(6) Research on artificial intelligence techniques to improvements of EW Sensors, Jammers and interactive EW systems.

o. Development of Image Classification and Terrain Analysis Algorithms for Use in Terrain Analysis (2)

Image classification and terrain analysis algorithms need to be interfaced to operate on a mini-computer efficiently and at high speeds.

p. Development of a Battery-Powered Field Operational Severe Environment Data Logger (2)

Development and production of one or more portable, battery-powered data loggers for field operation in cold and/or severe environments to be applicable to meteorological, soil thermal and/or hydrologic measurements.

q. Snow Moisture Meter (2)

Construct a solid-state device for field use at low temperatures with low power consumption. Detect the liquid water content of wet snow with a liquid content in the ranger of 1 to 10% by volume. Operate in the megahertz frequency range using parallel plate capacitors or any other viable approach. Read out directly as a hand-held instrument or bury in snow and monitor remotely.

r. Radar Independent Meteorological Sensing System (4)

There is a need for a meteorological sensing system which does not require radar tracking to determine wind speed and direction at different altitudes.

s. The Application of Mathematical Morphology to the Problem of Radar Image Feature Extraction (3)

Mathematical morphology has been used for image analysis in petrography, histology, study of cloud movements and computer reading. There are indications that mathematical morphology may be useful tool for terrain feature extraction from radar imagery.

t. Linear Feature Extraction From Radar Imagery (3)

Develop methods and techniques to identify and extract automatically or semi-automatically line features from radar imagery. Line features are: e.g., road systems, railroads, rivers, and boundaries between area features.

A83-002 TITLE: Distributed Command, Control, Communications, and Intelligence

DESCRIPTION: Development of dispersed, survivable command and control nodes with application down to the small unit level. The ultimate objective of this thrust is to design the architecture and systems to integrate battlefield information from all assets on the battlefield, distribute what each commander needs, and provide the opportunity for him to interact with a display/computer to permit precision fighting. Microchip technology, mass storage media, and interactive display technologies provide the technological development to accomplish dispersion command and control.

(5) Conceptual approaches to novel netted communication systems exploiting technological breakthroughs in microprocessors to yield orders of magnitude improvement in survivability against electronic and physical threats.

(6) Methods of exploiting short-term phenomena for reducing propagational losses, and translating these effects to product reliable special mode of communications techniques (for example, ducting, meteor burst, etc.).

(7) Improved low frequency air/metal coupling techniques to yield higher efficiency and higher gain without resorting to larger array sizes, larger radiating elements, enlarged reflectors, etc.

(8) Self-adjusting failure prevention techniques associated with analytical behavior of solid-state component designs.

(9) ADP hardware and software techniques (commonly vs. special purpose) for cells of a fluidly changing command post.

(10) Development of a machine for the composition and typesetting of Chinese text. This requirement is for psychological operations. (9)

A83-003 TITLE: Self-Containing Munitions

DESCRIPTION: Operations on future battlefields require the employment of self-contained (brilliant) munitions that can seek out and destroy the target in a lock-on-after-launch mode without operator (gunner) assistance. These terminal homing munitions (weapon systems) must be viable in the adverse battlefield environments of smoke, dust, haze, fog, rain, and active/passive countermeasures. Targets will be both hard and soft ground targets and a wide variety of platforms. Launch of the engagement system may be from ground on air platforms.

Specific technology areas of interest include:

a. Indirect fire antiarmor submunitions (8,14)
b. Autonomous acquisition algorithms and processors (8)
c. Midcourse inertial guidance techniques and components (8)
d. Minimum signature propulsion (8)
e. Air-breathing propulsion (8)
f. Fiber composite structures and materials applications (8)
g. Fiber optic guidance technologies (8)
h. Kinetic energy kill mechanisms (8,14)
i. Millimeter wave and submillimeter wave technology (8, 14,15)
j. Aerodynamics of maneuvering projectiles (8)
k. Passive sensing (14)
l. Automatic control (14)
m. Artificial intelligence (12)

n. Automatic recognition (8, 14, 15)
o. Propellant Chemistry (14)
p. Electro-optics (15)
q. Dynamics of Projectile Penetration in Snow (2)

Develop constitutive equations for projectile penetrations in snow. Must consider both blast effects as well as physics of projectile penetration of explosive munitions. Final form should be simplified for engineering applications.

A83-004 TITLE: Biotechnology and Chemical Defense

DESCRIPTION: Research and development efforts which emphasize the application of novel technologies, such as genetic engineering, and treatment of casualties on the integrated battlefield to include development of vaccines and antidotes. In addition, because of delays in evacuation or treatment, traumatic shock requires that research be performed to develop new treatment compounds, analgesics, and blood substitutes.

a. Chemical/Biological Agent Detection (14)

(1) Real Time Measurement of Spray Time Drop Sizes. Measurement of the size of liquid drops at the time of dissemination is needed to assess their actual configuration. Techniques are required to accurately measure the size and shape of liquid drops from the instant the liquid is disseminated until it hits the ground.

(2) Infrared (IR) Detector for Ambient Temperature Use. Laboratory demonstration of IR detector to replace cryogenically cooled Hg $Cd_{½}$ Te detector should operate between 8 and 12 um with a D* of $3.5x\ 10^{10}$ CM HZ watt desired.

(3) Passive Detective Techniques. Proof of principle demonstrations of passive (non-energy emitting) IR, UV, or microwave techniques for the detection of the following: (a) Chemical agents simulate aerosols (concentration path length 5 to 50 MG/M^2 particle size to 10 micrometer). (b) Chemical agent stimulant ground stimulant ground contamination (1 to 3 GM/M2). (c) Biological aerosols (bacterial virus, richettsia 5×10^{10} particles/M^2).

(4) Simple Lightweight Spectroradiometer. Concepts and design development of simple lightweight spectroradiometer operating between 8 and 12 UM with a 4-CM1 resolution. System should use few or no moving parts and have a noise equivalent spectral radiance of $1.5 \times .10^9$ W/CM^2 ER CM-1 at 1000 CC1 spectrometer or enhance steady grating spectrometer should be considered.

(5) Evaluation of Criteria for Spectral Pattern Recognition. Evaluation of linear discriminate functions, fisher discriminates variable increment classifiers, as well as other techniques to determine best approach to solve the spectral pattern recognition problem for IR passive remote detection.

(6) Sub micron Particle Analyzer. Automated, in site analysis of aerosols of various materials and shapes in sub micron sizes.

b. Chemical/Biological Agent Protection (7, 9)

(1) Materials Research. Materials suitable for protective mask, agent impermeable, transparent.
(2) Textile Technology. Agent impermeable textiles.

c. Materials Resistive to Chemical War (CW) Agents and Decontamination (7)

A variety of rubber-type, neoprene and plastics appear to be adversely affected by decontamination solutions/procedures after contamination by CW agents. A need exists to derive new/substitute materials for those

traditionally used in combat vehicles and which also exhibit either improved resistive or survivable characteristics to the vehicle/CW environments.

d. Battlefield Smoke (14)

(1) Smoke Clearing Techniques. Practical methods to clear large areas of smoke particles using low logistic techniques.

(2) Deagglomeration of Powders. Practical methods to break up powders into individual particulates immediately prior to dissemination. Air and electrical power are believed to be the most practical methods to drive the device.

(3) Methods to Transfer Powdered Smoke Agent from its storage container to the using device. The flow rate should be uniform but selectable, run without operator assistance, and efficiently transfer material so that little is left in the storage container.

(4) Treating and Packaging Techniques. Treat powdered smoke agent to prevent caking during storage. Packaging the treated powder in single trip containers to provide protection for extended storage in a field environment.

(5) Electrostatically Charged Dielectric Powders. Provide devices to charge relatively large mass flow rates of dielectric powder to selectable levels.

e. Water Purification Method (1)

Portable units capable of purifying polluted surface or ground waters from any of a variety of contaminants would be an asset under wartime conditions.

A83-005 TITLE: Soldier Machine Interface

DESCRIPTION: The transfer of operational burdens to the machine and a reversal of the trend toward manpower intensive systems. This area seeks exploitation of our society's unique abilities and opportunities to interface with computers. The objective is to maximize combat power by optimizing performance of both soldiers and equipment, individually or in combination and to achieve effectiveness equal to design capabilities of a system while not increasing a requirement for human skills not currently available in typical Army units.

a. Solider Performance

The major challenges for soldier Performance data in the future reside in the computer interface to include software, operation to include software, operations under adverse conditions, and basic data on today's soldiers Capabilities. Secondly operation under adverse conditions, particularly, in projected NBC Threat environment, will require much attention in the future. To conduct operations in this environment will require an assessment of the capabilities of the soldier and his protective equipment in such environments. Lastly, more data must be acquired to preclude the development of systems whose operation and maintenance exceed the soldiers ability.

b. Maintenance Capability (13)

Use of artificial intelligence (AI) to improve maintenance capability and productivity. As our systems become more complex, their maintenance becomes more difficult. The knowledge required to fault isolate and repair these systems can be stored in a computer. A small, portable, interactive computer equipped with AI and graphics can be an invaluable assistance to the maintenance personnel. This technology should be exploited to increase the capability and productivity of maintenance personnel

c. Robotic Vehicles to Detect and Neutralize Mine Fields and Barrier Ordnance (6)

Technologies are needed to enable tactical robotic vehicles to transit the battlefield ambient terrain, arrive at their mission point, and conduct barrier ordinance, mine detection, and neutralization functions.

Sensing close-in terrain features and obstacles from vehicles and provisions of output to enable automated decision making for the robot to go over, go around, descend, or avoid the terrain feature or obstacle

Process and hardware for interface of sensor information, directional decisions, and vehicle controls to effectively enable a tracked vehicle to transit amblent battlefield terrain given as assigned course.

d. Automated Ammunition Loading of Combat Vehicle (12)

Concepts for developing a system using robotics technology to rapidly handle palletized/utilized ammunition in a forward area.

e. Training (16)

Emerging technologies such as artificial intelligence (AI), voice synthesis and recognition, and computer-aided instruction (CAI) should be exploited to optimize the cost effectiveness of new training systems. Technological advancements are needed to provide for engagement simulation on an obscured battlefield and military operations in urban terrain (MOUT).

f. Heat Exchanges Used in vapor/Air Cycle Combat Vehicle Crew/Compartment Cooling Systems (11)

A need exists for high-performance, reliable, rugged, compact heat exchangers used as evaporators or condensers in air-to-air, refrigerants-to-air, coolant-to-air, and refrigerants-to-coolant heat exchangers. These components are required to perform, in typical combat vehicle induced environments of high dust concentrations/ingestion, temperatures, shock, vibration, salt spray, NBC contamination/decontamination, petroleum products, etc.

g. Helicopter Cockpit Ergonomics (13)

The pilot will be a critical limitation on mission performance in advanced helicopters such as LHX. The designer can provide more capabilities and systems than the pilot can possibly exploit; many of his tasks will have to be automated, and the tasks that remain will have to be made easy to perform. There is a need for increased research to define what must be automated, and the modalities for all controls and displays.

h. Assessing Cognitive Capabilities (5)

The focus of this area of research is to asses the cognitive skills and abilities which individuals bring with them to any given situation. The following are three areas of specific concern:

(1) Analysis of Individual Cognitive skills or intelligence of the Army is the development of methods for measuring skills or intelligence of individuals. Testing procedures that will provide this information are critical.
(2) Abstract Conceptual Ability. Particular interest is in how levels of abstract conceptual functioning relate to different levels of skills or placement within an organization.
(3) Measurements for Job Performance: Research needs to develop methods by which and individuals performance of job tasks, and how the performance related to overall unit performance can be assessed.

i. Instructional Techniques and Systems (5)

In an area of rapidly changing technology and soaring training costs, there exists the need to develop more rapid and efficient methods and systems for providing instructional training and retraining. This area includes three major subelements:

(1) Instructional Strategies. This research area involves methods for developing a better understanding of the ways by which individuals acquire new information (Individual Learning Strategy) and discovering the methods individuals use once they become proficient in solving particular analytic problems when they discard the linear paradigm by which they were taught (Analytic Reasoning Strategies).
(2) Computer-Based Instruction. Despite recent progress in computer based instruction (CBI) the areas of psychomotor skills training and performance measurement criteria need additional investigation in order to maximize the benefits of CBI.
(3) Expanding Learning Skills. Overcoming perceived natural limitations and improving and individual's ability to learn are current research needs.

j. Cognitive Processing Limitations (5)

Questions concerning the limitations on human cognitive processing and what can be done about to compensate are critical elements in this research effort.

(1) Man-Machine Interrogation. The overriding concern is to develop design guidelines to insure that future systems are compatible with the intended human user.
(2) Information Overload. Research should develop a schema for packaging information to assist with the overload condition under various levels of operational load and time pressures.
(3) Decision making. How people make decisions, what type of information they use, in what sequence they need the information, and what the actual processes are by which they arrive at a decision comprise this area of concern.
(4) Group Decisionmaking. Future systems will probably require decision making by groups of varying sizes not collocated. Research in this method of decision making is necessary if future systems are not to be completely utilized.

k. Artificial Intelligence Application (5)

Many of the new systems and modified existing systems will require applications of Artificial Intelligence (AI). Necessary and sufficiently minimal conditions for symbolic processing must be explored. Research needs to be conducted in the following areas:

(1) Learning. This should include methods to incorporate new Information from the outside environment into the existing data base.
(2) Knowledge Representation. This area should examine the construction and modification of the world view, coding, collating, organizing, storing, and retrieving input information, representation of expert knowledge and machine creativity.
(3) Problem-Solving. Areas for research include: heuristic problems solving, rule-based problem-solving, goal-directed problem-solving, nonlinear problem solving, inductive reasoning, and distributed problem solving/network control.
(4) Planning. Machine planning is critical to any true AI system. The areas of research need to include structure planning, goal generation, incorporation of the user's value judgments, constraint modification and alternatives, distributed planning, generic planning, and Meta planning.

l. Artificial Intelligence/Robotic Supplement to Medical Support (17)

Tremendous numbers of casualties can be expected on the battlefields of the future. This influx of causalities may overwhelm traditional systems for casualty retrieval, transport, and treatment. The potential exists to use computer-controlled devices to detect casualties on the battlefield, determine if they are still living, and allocate resources to retrieve them. It is even conceivable that robots could carry out, or at least assist in, the actual retrieval. Computers could assist in the diagnosis at the aid station and in administering therapeutic measure during transport to better medical facilities.

A83-006 TITLE: Medical Support

DESCRIPTION: Support in battle requires healthy troops. Disease can threaten the success of military operations, as can the hazards generated by our own systems. Just as effective medical defense must be developed and made available to protect the soldier against infection or contamination. Research must also be conducted to define the hazards of our systems and to protect out personnel against them. In the field, the objective is to improve prevention and treatment of disease, particularly those exotic diseases endemic to areas where American soldiers may have to fight. In addition, new types of weapons will be appearing and medical research must be conducted to determine how these weapons will affect personnel and to help devise ways to protect personnel.

a. Diagnosis of Natural and Induced Diseases of Military Importance (17)

This effort is designed to provide state-of-the-art technology to develop a system for rapid identification and diagnosis of agents or diseases acquired naturally or by exposure to biological weapons. The system will provide for rapid identification of agents/diseases through examination of clinical specimens such as blood, urine, spinal fluid, and throat washings. The system should be extremely sensitive using very specific reagents such as monoclonal antibodies prepared through hybridoma technology. Methods utilizing the latest in biotechnology techniques should be utilized, such as labeled molecular probes for the identification and analysis of microbes or their products.

b. Subunit Vaccines for Militarily Important Diseases (17)

Subunit vaccines are those which are composed of key portions of killed microorganisms. The aim of this effort, therefore, is to rid the killed microorganisms of undesirable components by utilizing the techniques of microbial engineering and identifying just those parts of an organism that are able to produce immunity without side effects and to utilize genetic engineering to produce these purified antigens in large quantities.

c. Ballistic Injury (17)

Basic medical research is needed to differentiate wounding effects from high-velocity missiles as compared to low-velocity missiles and the effect of these differences in treatment regimens.

d. Burn Injury (17)

Feasibility studies are required to construct appropriate animal models to permit research on the physiological and biological systems affected by burn injuries. Specific areas requiring research are: role of surface active agents in burn inhalation injury and how these can be artificially constructed and used; cellular reaction to burn inhalation injury and methods for treatment; and role of artificial skin in covering burn wounds and prevention of infection.

e. Design and Synthesis of Novel Compounds as Pretreatment, Prophylaxis and Antidotes for Chemical Warfare (CW) Agents (17)

New compounds based on rational scientific premise are required for evaluation to protect and/or treat personnel exposed to CD agents. These agents include the nerve agents, hydrogen cyanide, mustard, and Lewisite. Effectiveness, toxicity, ease of synthesis, and scale-up potential are important considerations in the design of these compounds.

f. Innovative Approaches for Decontamination and Detoxification of CW Agents on Skin (17)

The rapid inactivation and/or removal of toxic CW agents from skin is an important consideration in the event of chemical exposure. New approaches compatible with human use and having the potential of meeting FDA guidelines are required for evaluation as potential skin decontaminants.

g. Mechanisms of Action Mustard (17)

The vesicant agent, mustard, produces a high morbidity for unprotected personnel. Little is known of the mechanism of action of mustard so that effective protection and/or treatment can be developed. Studies should attempt to define the etiology of mustard poisoning to aid in the development of effective countermeasures.

h. Vital Signs Monitor (17)

There is a continuing need for innovative approaches to noninvasive, real-time measurement of vital signs of casualties who are enveloped in chemical protective over-garments. Current detection capabilities are for heart rate, blood pressure, and respiratory rate. Long-range planning envisions the need for smaller and lighter devices with the capability to noninvasively measure additional vital signs.

i. Resuscitation (17)

There is a research requirement in the area of resuscitation. Innovative approaches to casualty resuscitation using manual or external powered devices are needed. Developmental criteria include small size, minimum weight and simplicity of operation. The manual devices must be designed for use by non-medical personnel to provide emergency resuscitation for chemical casualties without creating additional exposure hazard to the casualty.

j. Patient Dosimetry (17)

There is a critical need for innovative research and ultimate development of dosimetry methodology to: (1) determine exposure to chemical agents, including type of agent; (2) determine exposure dose; (3) determine adequacy of decontamination. While the ultimate goal is a single device to accomplish required functions, innovative ideas addressing one or more required functions are required.

k. Attenuated Vaccines for Militarily Important Diseases (17)

Attenuated vaccines are those that include living disease microorganisms that are not virulent enough to cause disease when inoculated into healthy individuals. Yet the attenuated vaccine will stimulate immunity in an individual against virulent forms of the disease organisms. The objective of this effort is to employ genetic manipulative techniques to alter the virulence of disease organisms so they can be used in attenuated vaccines. Effective vaccines are needed against natural diseases and potential biological warfare agents.

l. Health Effects of Directed Energy Weapons (17)

The potential exists for the development of laser and microwave weapons. If these are developed, medical research must be conducted to determine how theses weapons can damage the body, how this damage can be prevented, and how it can be treated once it occurs.

m. Field Water Supply (17)

Water has often been a major factor in deciding the outcome of battles in areas where it is very scarce or where it has been contaminated, either naturally or by man. Preventive medicine personnel must periodically test both the raw water sources and the treated water to insure that it is safe for use by military personnel. Medical research is needed to modernize the test equipment provided to theses preventive medicine personnel. Technology used in current test kits is sometimes over 20 years old and can be very slow and inaccurate. Field equipment is not available to detect and analyze chemical and biological warfare agents at the levels which may have health impacts at the water consumption levels expected in arid environment.

n. Temporary Dental Restorative Material (17)

There is a continuing need for a temporary dental restorative material for rapid treatment of dental caries in the field and during mobilization. The material should have the following characteristic: be compatible with dental and oral tissues, requires little or no cavity preparation and be technique insensitive in order that it may be used by semiskilled dental auxiliary personnel remain functional approximately 12-18 months, not require special storage conditions, and remain stable over a wide range of temperature/humidity conditions.

o. Tissue Adhesive (17)

A biocompatible adhesive(s) I required for rapid treatment of soft and hard tissue wounds.

p. Dental Anesthesia (17)

Dental treatment in the field by semiskilled dental auxiliary personnel requires a rapid, noninvasive method for selective anesthesia to individual teeth.

q. Dental Screening System (17)

Mobilization of large numbers of personnel necessitates examination for dental pathology. A rapid, automated system is required to screen and identify troops at risk of experiencing a dental emergency in order than they can be treated.

r. Bone Substitute (17)

Biocompatible synthetic materials or despeciated bone are required for repair/replacement of bone to eliminate secondary surgical procedures to obtain autogenous bone for grafting.

s. Wound Dressing (17)

Due to delayed evacuation for definitive treatment a field bandage is required which can control hemorrhage, infection and pain.

t. Sterilization (17)

A non-autoclaving method for rapid sterilization of surgical and dental instruments, operating room linens, and other supplies is required in forward areas to reduce the quantity of instrument/supplies needed and logistical support.

u. Field Equipment (17)

Surgical, medical, and dental diagnostic and treatment items and equipment systems used by units deployed in forward combat area must meet the following requirements: small cubic size, lightweight (individual items must be one/two-person portable), energy and resource efficient, and resistant to moisture or chemical agent contamination. Electronics, where required, must have a multi-source capability, be electromagnetic pulse resistant, and capable of modular replacement.

v. Cleansing (17)

A non-water-requiring skin sterilization system for hand cleaning and operative site preparation is required for forward field use. Also, a non-water-requiring bathing system that does not dry the skin is required for soldiers' personal hygiene as well as nonirritating depilatory.

w. Drugs (17)

A short-acting (onset 30 minutes – duration 6 hours) non-sedating anxiolytic that does not interfere with mentation is needed in treatment of psychiatric battle casualties.

x. Suction Device (17)

A lightweight device providing controlled suction over a range of 100-100 cm water powered other than electrically is needed for various tube and operative site usage.

y. Infusion Device (17)

A nongravity-dependent intravenous infusion device that can deliver measured amounts of fluids at a constant reliable rate without technical supervision is needed for mass casualty and transport of wounded.

z. Laboratory (17)

A rapid, simple, accurate and reproducible method of urine, serum sodium, potassium, chloride, creatine, blood glucose, and urea nitrogen as well as blood ph, oxygen and carbon dioxide determinations is needed.

A83-007 TITLE: Combat Equipment and Materials

DESCRIPTION: Support of future armies calls for development of new and improved materials and equipment. New metals with improved armor capability are always important, while requirements for more adaptive, fuel-efficient, and mobile equipment are emerging. In the area of combat equipment, the following subtopics are suggested for investigation:

a. Improved Propeller/propeller coating for Erosive/Corrosive Environment (6)

Operation of Army air cushion vehicles in amphibious resupply across beach areas results in extreme erosive effects of sand and water coming in contact with propellers, development of materials/coatings for propellers to decrease the erosive/corrosive effects of the military environment are needed.

b. Portable Electrical Generating and Power Conditioning Equipment for Field Use (6)

Portable electric power units currently deployed are used in very large quantities consuming about one-quarter of available mobility fuels. Current R&D is focused on fuel cells, thermo-electric and photo-voltaic systems, and advanced types of internal and external combustion engines with associated electrical components and controls. New technologies are needed which will reduce costs; improve reliability, maintainability, and efficiencies; be capable of operating on alternate fuels; and have reduced acoustic and thermal radiation. Power conditioners are necessary to convert indigenous power sources to US standard voltage and frequency. They must be compact, durable, lightweight and long-lived for deployment in hostile environments and operated by semiskilled personnel.

c. Development of Technologies that will Allow Army Equipment to Operate on a Variety of Fuels as They Become Available (6)

Current fuels research is addressing alternative fuels, and fuels derived from renewable biomass sources. Technology is required to permit interchangeability of fuels in standard field equipment.

d. Portable Vehicle Engine Exhaust Water Recover/Treatment System (6)

Water can be potentially produced from engine exhaust gases could be used to develop a vehicle closed loop water support system. The development of a closed loop system such as developed by NASA to support spacecraft operations is especially important in a highly mobile integrated battlefield.

e. Chlorine-Resistant Reverse Osmosis Elements (6)

Develop chlorine-resistant reverse osmosis elements to allow pre-chlorination of water for Army's new reverse osmosis water purification unit.

f. Research in Advanced Composites (7)

(1) Feasibility of using ultrasonic excitation to enhance the liquid resin infiltration of glass fiber and graphite fiber in the preparation of organic matrix composites. An analogous study could be undertaken for the infiltration of molten metal into tows of graphite fiber and silicon carbide fiber in the making of metal matrix composites.

(2) Hybrid composite materials for structural applications: Army applications such as aircraft, missiles. Remotely piloted vehicles, ground vehicles and artillery require advanced materials for improved mobility and determination of required structural design criteria. Materials under consideration include hybrid composites composed of differing materials; i.e., ceramics/organic composites and similar combinations.

g. Research in Ceramic Material (7)

Feasibility of forming net-shaped ceramic parts by self-propagating stoichiometric reaction in a closed container. The reactants could be either in the liquid, solid, or gaseous state and exothermic reactions, once initiated, would seem self-propagating to completion. The physical structure of the product would seem to be related to the ratio of the reaction temperature to the melting point of the product. It may be possible to "cast" high melting-point ceramics such as silicon nitride to complex net shapes by this means.

h. Non-Newtonian Fuel Additive (6)

Investigate feasibility of using additives for drag reductions in military fuel pipelines and hoselines of six to eight inches in diameter; type of additives method of application, costs and benefits, sources of supply.

i. Attenuation of Noise Sources from Various Components Used in Military Vehicles (see subparagraph below)

(1) Development is needed of a means to isolate the operators in the operator's compartment from the high propeller noise environment on air cushion vehicles. Noise level reduction from 99 to 85 DBA is desired. (6)

(2) A variety of electrical/hydraulic motors, pumps, fans, and blowers noise impositions on crewmembers. Acceptable methods of acoustic control/reduction for these kinds of components would assist in resolution of the problem. (11)

j. Automated Diagnostic Equipment (6)

A solid-state data recorder providing diagnostic data and real-time information on duty cycles of electric power generating equipment is necessary to predict maintenance requirements, define mission profiles, and validate equipment sizing. This type of automated equipment would record voltages, current, power frequency, pressure, duration, and energy with frequency or time of occurrence.

k. Corrosion Research on New Materials (6)

New alloys and non-oxide ceramic materials are under consideration for replacement of "super alloys" in military equipment. New corrosion prevention technologies must be developed for these materials to retain the necessary high-strength characteristics.

l. Urban Warfare Explosives Detector (6)

Future military operations in most areas of the world will involve fighting in urban terrain. High speed, portable devices are required to detect and locate the explosive contents of mines, booby traps, demolition charges, and remotely activated munitions concealed within this terrain.

m. More Efficient Utilization of Fuel in Light Trucks and Off-Road Vehicles (11)

Current research is focusing on adiabatic diesels, ceramic components in gas turbines, and advanced transmissions, new technologies are required in fuel management and/or high-strength materials for power trains which will provide reduced weight and increased fuel economy.

n. Lightweight Materials and Materials Systems with improved Armor Capability (7)

The primary threats to armor systems include small, medium, and large caliber weapons aw well as chemical energy warheads. These threats have shown a steady growth in lethality such that protection with conventional armor requires prohibitively high weights.

o. Joining Technology (7)

More effort is needed in the development of joining technology for difficult-to-weld materials or material combinations used in present and planned Army systems. Such materials would include ultrahigh hard steels, matrix composites, and ceramic/metal combinations. In addition, the development of automated welding and thermal cutting systems utilizing adaptive controls is needed.

p. High-Density Kinetic Energy Penetrators (7)

One of the primary threats to tank armor is high-density kinetic energy penetrator. Because of the increased armor protection it is necessary to produce a penetrator with better ballistic performance. At the present time the penetrators are fabricated from staballoy (depleted uranium) or tungsten alloys. All future penetrators that are to be used in the large caliber gun systems (120 mm) are scheduled to be fabricated from staballoy. This material (Staballoy) constitutes a health hazard because of its toxicity. Therefore, it is imperative that an intensive research program in tungsten materials be initiated to improve the mechanical properties of tungsten materials that will achieve the ballistic performance of staballoy and eventually replace staballoy as a penetrator material.

q. Manufacturing Methods for the Economic Application of Lightweight High-Performance Materials (7)

Effort would include demonstrating the feasibility of manufacturing techniques for producing components from lightweight materials for those applications in which high strength/weight or high stiffness/weight rations are required.

r. Measurement Techniques Instrumentation and Automatic Test Equipment (7)

Work involving high-frequency ultrasonic equipment in the 30- to 100-MHz range, with the objective of inspecting smaller critical flaw sizes. Development of software for automated test equipment, with the objective of eliminating human error during the inspection process.

s. Fatigue Indicator (6)

A concept is required for indicating and/or measuring the amount of structural fatigue a component. The approach may consider such methods as visual, ultrasonic, chemical, mechanical, and electrical that will reliably measure and indicate the expended structural life. The device/system must be rugged, self-sufficient, and easily operated in order to be useful and survive in the typical environments experienced by military bridges.

t. Marker Beam for Roof Moisture Surveys (2)

Develop source of beamed electromagnetic energy for use in nondestructive testing to locate wet insulation in roofs on buildings.

u. Portable Ground Water Flow Measurement Device (2)

Develop battery-operated device for determining direction and rate of ground water flow in test holes.

v. Accurate Metal Detector (2)

Develop a subsurface metal detection device effective to a depth of 36” within ½” accuracy.

w. Alternate Fuels or Facilities (1)

Develop alternate fuels for heating fixed military facilities.

x. Construction Technology Forecasts (1)

Conduct technology forecasts and assess potential impact on military construction.

y. Artificial Intelligence for Building Design (1)

Develop artificial intelligence applications for use in automated design of military facilities. Potential for application exists in automated design systems that are being implemented by the Army Corps of Engineers.

z. Air Surface River Ice Thickness Measurement Device (2)

There exists a need for a device to measure (nondestructively) fresh water ice thickness from the upper ice surface on frozen lakes or rivers. The hand portable device should be capable of making point (maximum 6-inch-diameter area) measurements of ice thickness. The transducer may, but need not, contact the ice surface.

aa. Cold Water Pavement Material (2)

Development of a quick-setting material which can be poured or blown into larger cavities or depressions at temperatures of 0ºF and which would reach and unconfirmed compressive strength of 300 psi within a few hours.

bb. Abrasion-Resistant Urethane Coatings (1)

Research to develop environmentally safe high solids, high-build, abrasion-resistant urethane coating for metallic substrates subjected to submersion.

cc. Innovative Methods for Field-Expedient Waste Disposal (1)

Health and hygiene concerns in the field require a totally new concept or innovation for human waste disposal.

dd. Recycling System for Contaminated Fire Fighting Foams (1)

The design of a recycling system would reduce material costs and reduce water treatment costs.

ee. Handheld Short-Pulse Radar (2)

There is a need for a short-pulse radar system to measure ice thickness. The system must be small, lightweight, easy to operate, and produce a hard copy display.

ff. Radiosonde Balloon Ice Detector (2)

A “throw-away” ice detector is desired for use on radiosonde balloons.

gg. Synchronous Video Recorder (1)

Develop a video recorder capable of changing speed of recording with ability to synchronize with vehicle speed to maintain a constant number of frames for a given traveled distance.

hh. Shock Isolation Equipment (1)

New concepts in shock isolation of equipment. Concepts should include use of new materials or design linkages for application to a wide range of equipment from computers to equipment containing structures to resist seismic and/or nuclear ground shock.

ii. Mine/Countermine System Analysis (3)

Determine performance characteristics required by airborne sensor(s) for mine detection in specific geographic areas and to develop interactive image processing hardware/software capable of detecting surface and/or buried mines in a homogenous or heterogeneous environment.

jj. Field-Portable Probe of Similar Device for Measuring Soil Moisture Tension (3)

A need exists for a simple and portable device that can be used to sample soil moisture and soil temperature characteristics.

kk. Gyrocompass with Reduced Susceptibility to Shock, Vibration, and Motion (3)

The accuracy of present gyrocompasses is limited primarily by susceptibility to shock, vibration, and a motion of the vehicle or weapon. It is desired that the gyro provide an accuracy of 0.5 mil (1.69 minutes of arc) or better when operated in Army tactical vehicles and large caliber weapons while firing.

ll. Multicolor Software Display (3)

There is a need for a large-scale, high-resolution multicolor software display to proof and display maps and charts.

mm. Analytical Study of Soil Pore Pressure Response Under Dynamic Loadings (4)

Measurement response time of pore pressure is a function of a number of soil properties and travel paths of the fluid pulse to the measurement transducers. Given the necessary test boundary conditions, an analytical study is required to identify and quantify those variables affecting the measured response.

nn. Development of Dynamic Airblast Gage for 80,000 psi Explosive Environment (4)

The intended use for the gage is to measure airblast and impulse (i.e., actual impulse per unit area or the time integral of the airblast) from explosive detonations.

oo. Development of a Deflection Measurement System to Operate Under Dynamic High-Pressure Loadings (4)

There is a requirement to make high-resolution measurements of soil deflection under extremely fast (100sec) transient loadings. Because of the constraints of the experiment, the noncontracting type of measurement must be made within a pressure environment of up to 1- ½ kbar.

pp. Materials Resistive to Chemical Warfare (CW) Agents and Decontamination Solutions (11)

A variety of rubbers, neoprene, and plastics appear to be adversely affected by decontamination solutions/procedures after contamination by CW agents. A need still exists to derive new/substitutes materials for those traditionally used in combat vehicles and which also exhibit either improved resistive or survivable characteristics to the vehicle/CW environments.

qq. Lubricants Resistive to Chemical Warfare (CW) Agents and Decontamination Solutions (6)

Lubricants currently employed by military ground vehicles appear to be susceptible to absorption of CW agents and subsequent dissolving by D8-2 decontamination solution. A resistive substitute lubricant/technique satisfying CW and all other standard military requirements could help resolve the problem.

rr. Attenuation of Noise Sources from Various Components Used in Combat Vehicles (11)

A variety of electrical/hydraulic motors, pumps, fans, and blowers employed within combat vehicle crew compartments contribute to unacceptable noise impositions on crewmembers. Acceptable methods of acoustic control/reduction for these kinds of components would assist in resolution of the problem.

A83-008 TITLE: Ballistic Missile Defense Systems (All paragraph 8 topics submit to 18)

DESCRIPTION:

a. Software Development Technology – Tools and techniques designed to improve the ability to produce high-quality software systems in a rapid manner.

b. Software Quality Assurance – Research in tools and techniques designed to allow the quality of software to be effectively assessed through computer-aided support.

c. Distributed Computing Development – Development of tools and techniques designed to aid in the ability to develop distributed computer systems for a real-time environment. Includes work in distributed languages, databases, and control.

d. High-Repeating-Rate Explosive Flux Generators – New concepts for accelerating projectiles, such as electromagnetic guns, provide novel, reliable cost-effective potential for nonnuclear kill BMD systems. In order to exploit electromagnetic funs for BMD applications, very large energy levels that can be pulsed repeatly many times a second must be available at relatively low cost.

e. Novel Control Mechanisms for the In-flight, Accurate Guidance of Small, High Velocity Projectiles – for a highly reliable utilization of MBD by projectile impact, where all of the propulsive energy is provided to the projectile at the instant of launch, mechanisms for continuous guidance and control on board the projectile would greatly enhance its effective arrival at the required point of impact. Very high projectile requirements along with volume, weight, configuration, and cost-constrained projectiles establish the major difficulties in this area.

f. Damping and Control of Stress Peaks in BMD Interceptor Materials – Worst-case shock and thermal loads that dicate minimum BMD interceptor materials requirements inflict severe penalties on optimizing interceptor performance and cost. Novel techniques such as control of material porosity at expected stress peak sites could reduce size, weight, and the high cost of developing new, exotic materials for such purposes.

g. Millimeter Wave Technology – Study the feasibility of adding MMW radar to an optical aircraft which could add accurate range measurements to targets detected optically and also have the capability of performing some of the discrimination tasks from the aircraft.

h. Submillimeter (3-114) Wave Agile Beam Steering – Techniques for a rapidly steered antenna apertures 2.30 cm for moderate power coherent laser beam.

i. 95 GHz Agile Beam Antenna – Techniques for rapidly steering radar antennas comparable to phased-array radars.

j. Optical Signature Simulator – A test set for generating and evaluating performance comparable to optical sensors.

k. Flash Annealing of Ion-Implanted Doping Profiles – The evaluation of a process for FaAs device annealing which circumvents the problems associated with the current high-temperature annealing approach.

A83-009 TITLE: Other Topics of Special Interest

DESCRIPTION: This topic seeks to promote innovative solutions to scientific and technical problems not specifically covered in the Thrust Areas above, but is of interest to the special mission that the army performs.

a. Electrically Passive Flight Control System Sensor (13)

As automatic flight control functions such as airspeed hold, altitude hold, etc., become more important to both mission success and flight safety, some means of sensing aircraft state parameters via electrically passive optics becomes highly desirable. This would provide increased assurance that improved helicopter-handling qualities would be maintained in severe combat environment.

b. Load-Attenuating Seat Cushion (13)

Develop a seat cushion of minimum thickness that gives both maximum comfort and minimum dynamic overshoot for crashworthiness.

c. G indicator (13)

Develop a "paint," thin material, etc., that can be simply attached to a panel in an aircraft structure, that in the event of a crash records the maximum acceleration in the area to which it is affixed. The material must be lightweight, small, and inexpensive to buy and install.

d. Hard Coatings for Optical Systems (7)

Broadband sensors require hard, erosion-resistant coatings, which are transparent from ultraviolet, through the visible, and well into the infrared radiation wavelengths. New concepts for such coatings compatible with state-of-the-art optical materials are desired.

e. High-Power Silicon Transistors (15)

Need for high-power solid-state devices in the 100-1000 MHz range. Desirable performance of 150-300w cw with 6-10dB gain over bandwidths of up to 400MHz. Efficiency of 50 percent or better is desired. High operating voltage is considered a positive asset.

f. Processing of Microwave and Millimeter Devices (15)

Processing of microwave and millimeter devices by molecular beam epitaxy and metal organic chemical vapor deposition into microwave and millimeter wave devices such as sources, mixers, and control devices.

g. Image Line Monopulse Antenna (15)

Develop monopulse front ends using image line technology to be used in millimeter wave seekers.

h. Positive Plate Materials (15)

Synthesize small amounts of new anode catalysts for rechargeable lithium batteries. Intercalates will be descried in terms of chemical content, structure, etc., in quantities of 100 grams each.

i. Electron Beam Resists (15)

Conception, fabrication, development, and testing of extremely sensitive (few micron c/cn squared) electron beam resists.

j. Supermatrix Structures (15)

Conception and development of ultrasubmicron lithographic feature capability for quantum-well supermatrix structures.

k. Ferrite Films (15)

Synthesis and characterization of GHz narrow ferromagnetic resonance linewidth (less than 40 oersted) hexagonal ferrite films for 95 GHz resonators.

l. Displays (15)

R&D ideas and approaches to solving problems of high speed display subsystem architecture including interactive computer graphics techniques: Maximum display information transfer including use of color and other contrast-enhancing techniques and application of artificial intelligence for display/computer/human interaction.

m. VLSI Interconnects (15)

R&D ideas and approaches to solve VLSI interconnect problems such as maintaining connectivity over steps and achieving multilevel metal interconnects.

n. Packaging (15)

Ideas and approaches to solve microelectronic packaging such as mounting of chip carriers (greater than 200 leads), low-k "mother" board materials for high-speed circuits, and a controllable (during manufacture) coefficient of thermal expansion to match "mother" boards to chip carriers.

o. Test Software (15)

Ideas and approaches to the generation of microcircuit test patterns in use throughout the Government and industry.

p. Nonreciprocal Near-Millimeter Wave (94,140,220 GHz) Passive Devices Research (15)

Innovative nonreciprocal passive devices are needed for future near-millimeter wave radar, fuze, guidance, and communications systems. These devices are needed to perform the standard microwave functions of modulation, phase shift, isolation, limiting, duplexing, and filtering. However, standard microwave design techniques for these devices produce poor performance. Innovative new design principles, materials, and techniques including new transmission line media other than waveguide are needed to achieve high performance at low cost.

q. Near-Millimeter Component Calibration (15)

Program to calibrate and measure accuracy of performance for passive, near-millimeter wave components are needed. This program includes such devices as attenuators, frequency meters, wave-guide transition, power meters, etc. Diagnostics capability to span the spectral region of 90-250GHz would be required.

r. Sealed Lead Acid Storage Battery (15)

Develop activated lead acid storage battery plates with a minimum of 80-percent charge retention capability after storage in excess of 24 months. Design of plates and the ultimate cells shall be applicable to a military battery configuration in a permanently sealed battery design.

s. Microprocessor-Based Energy Analysis Programs (1)

Simple energy analysis computer programs are needed to evaluate alternate design options for new construction and evaluation of retrofit alternatives for existing buildings.

t. Technologies for Diagnosing Building Energy Inefficiencies (1)

Diagnostic techniques are needed by which a building can be evaluated to pinpoint specific retrofit opportunities.

u. Automatic Diagnostic Equipment (1)

Methods are needed for providing diagnostic data and real-time information on duty cycles of electric power generating and energy-using equipment to predict maintenance requirements, define mission profiles, and validate equipment sizing.

v. Artificial Intelligence for Building Design (1)

Develop artificial intelligence applications for use in automated design and operation of military facilities.

w. Alternate Fuels for Facilities (1)

Simple, low-cost methods for converting alternate fuels to heat, cooling and electric power for Army facilities are needed. Methods for cost-effective fuel utilization in equipment sized for individual buildings to a group of buildings (6 to 10) are to be investigated.

x. Ice Detector for Structural Applications (2)

A need exists for an ice detector deployable as part of standard meteorological packages. This detector should be low power, low cost, and give verifiable output that can be used to extrapolate up to design loads for towers, communication dishes, powerlines, and the like.

y. Natural Language Query for Building Design (1)

Natural language query procedures need to be devised to provide automated building design system access by architects and engineers. This will eliminate the intensive training ordinarily required for accessing automated building design.

z. Expert System for Engineering Deficiencies (1)

A method is needed which links historical engineering design and construction deficiencies with planned Army construction. The idea is to forecast potentially repeatable problems which can occur in planned projects and alert designers and constructors in advance.

aa. Paint Remover (1)

Research to develop an environmentally safe, low-cost, rapid technique for removing multiple layers of existing paint from wood substrates without damaging the wood.

bb. Pipe Repair System (1)

Research to develop and demonstrate low-cost, rapid linking systems to repair and upgrade existing in-place pipe networks.

cc. Leak Detection Device (1)

Research to develop a leak/location device for low-pressure water and other liquid distribution systems.

dd. Underground Construction (1)

New concepts in underground construction of large facilities. Concepts should be aimed at providing low-cost hardened structures.

ee. Gas/Particulate Interfaces of Hexachloroethane Training Smokes (1)

Hexachloroethane smoke consists of submicron particles of chlorides of Zn, Cd and Pb. Define the physical chemistry of the gas/particulate interaction by determining qualitatively and quantitatively the gas phase compounds that are attached to the chloride particles, and whether this changes with particle size/growth.

ff. Soil Analysis of Hexachloroethane Smokes Residues (1)

Characterize and quantify the level of cadmium, zinc, lead, arsenic, hexachlorobenzene, hexachloroethane, and perchloroethane in control and test soils on Army training areas at the surface down to 10cm in depth.

gg. Frost Heave Model Improvement (2)

Develop relationships for pore water pressures (suctions) versus moisture content and unsaturated hydraulic conductivity versus pore water pressure or moisture content.

hh. Remote Sounding System for Subsurface Detection (2)

There is a need for a remote sounding system capable of detecting cavities under pavements. Current systems do not allow for rapid survey of large pavement area.